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DRAWINGS ATTACHED

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(54) STATOR ASSEMBLY FOR ELECTRIC MOTORS

(71) I, KURT REICH trading as KARL M. REICH MASCHINENFABRIK, a German citizen, of Kisslingstrasse 1, Neurtingen, Wuerttemberg, Germany, do hereby declare

the invention, for which I pray that a Patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a stator assembly for an electric motor, having an insulating body with an end plate which covers at least one end face of a lamination pack, and formed integrally with a part lining at least half the total slot space of the lamination pack.

Known insulating bodies, made of a thermoplastics material by injection moulding, have two halves, each having an end plate and a part which corresponds to the slot space over approximately half the axial length of the laminated pack, and the two parts which line the slot overlap one another at the middle of the axial length of the laminated pack to provide an adequate creepage path.

The provision of insulation between the laminations and the coil is facilitated by using such an insulating body in place of insulation which consists of individual insulating films inserted into the slots, and end plates separate from the said films and the time required for performing the operation is reduced. However, the winding itself must be produced as before by manual insertion of individual pre-formed coils into the slots. A winding machine cannot normally be used because the enclosed ends of the coils must be shaped so that they are clear of the bore.

It is an obect of the invention to permit machine winding of the stator packs of electric motors having salient poles.

According to the invention a stator assembly comprises a lamination pack having winding slots defining pole members and an insulating body having an end plate covering at least one end face of the lamination pack, the said end plate being integral with a part of the insulating body which covers at least half the total surface area of the sides of the winding slots, and in which each end plate includes a wall shaped like the segment of a circle and extending axially outward from the end plate in line with each stator pole member and also extending beyond the pole tips in the peripheral direction.

The winding shoes necessary for performing mechanical winding can be secured to and centred on these walls. For fixing the winding shoe in a peripheral direction for example a recess in the wall may be utilised, while for securing the winding shoe in an axial direction a groove may be provided in the winding shoe, into which the free edge of the wall extends.

These walls prevent the coil winding from entering the bore of the lamination pack. At the same time there is no loss of wire tension in the wound coil due to the winding machine so that a compact winding is obtained, the individual turns of which are tightly pressed against one another. Such a compact coil is especially suitable for impregnation with resin. A good adhesion of the individual turns is thus achieved, so that the loosening of individual turns through oscillation or shock becomes impossible.

In addition, the coil heads are firmly attached to the end plates of the insulating body, whereby a minimum size of the wound stator, small copper content, small electrical resistance and good heat conductivity is achieved; the last two points mentioned enable the efficiency of the machine to be increased or for the same efficiency permit heating to be reduced.

Finally, there is also the advantage that after the winding operation the coil head is in its final form and does not need to be pressed into shape by pressing tools, as is the case with prefabricated coils. By this means manufacturing time is further reduced as compared with the use of a winding machine which places the coil wires directly

[P

into the slots and to the use of an inserted insulating member.

Preferably the axial length of the walls is at least equal to the projection of the coil heads in the axial direction, so as to make sure that not even the upper turns of the coils can slide off.

Because the walls extend beyond the pole tips in the peripheral direction the slot space which is available for the coil winding is increased without the magnetic properties and therefore the commutation of the machine being altered, as would be the case if, for increasing the slot space, the pole tips of the laminated pack were extended. Moreover, individual turns which were not completely stuck on to the guide walls when applying the resin cannot reach the path of the armature.

For increasing mechanical strength the two edges of each wall extending into one pole gap can be formed with a rib-like projection which extends along the edge of the part filling the slot space and into the pole gap, the said edge extending in the same direction and the projection being made integrally therewith.

To facilitate the winding and to save space the free corner zones of each wall can be chamfered off. Since the coil head merges into the flange of the coil in their region, i.e. its height is less than the middle region, the reduction of the height of the wall brought about by the chamfering off is without significance.

The insulating body may consist of two halves which, however, are of identical design. The advantage of this is that for the production of the two halves one mould only is required.

The parts which form the slot space can be constructed so that they overlap in the middle of the length of the laminated pack. In the region of the overlapping edge zones these two parts can have their wall thickness reduced by half, the reduction being effected on one half of the circumference on the outer side and on the other half on the inner side of the edge zone. Alternatively, the parts forming the slot space can each line two slots adjoining a pole gap. In this connection the arrangement can be such that the edge remote from the end plate of the part forming the slot space of one half of the insulating body can be inserted into the end plate of the other half, whereby the slot space insulation may be secured in the desired position until the coil winding presses same against the laminated pack.

Two embodiments of the invention will now be described by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a side elevation partly in section of a wound stator pack, including a first embodiment of the insulating body of the invention;

Figure 2 is a front elevation of the insulating body of Figure 1;

Figure 3 is a view of one half of the insulating body according to Figures 1 and 2 seen from the side facing the lamination pack;

Figure 4 is a section on the line IV—IV of Figure 2;

Figure 5 is a section on the line V—V of Figure 3;

Figure 6 is a plan of the side facing the lamination pack of one half of a second embodiment;

Figure 7 is a section on the line VII—VII of Figure 6; and

Figure 8 is a section on the line VIII—VIII of Figure 6.

For insulating two coils 1 and 2 from a stator lamination pack generally indicated at 3 for a two-pole motor with salient poles, an insulating body is provided consisting of two identical halves 4 and 5. The insulating body is made of a thermoplastic and is produced by injection moulding. Since the two halves 4 and 5 are identical, they can be produced in the same mould.

The half 4—and the same applies to the half 5 due to the identical construction—consists of an end plate 6, the shape of which is substantially identical with the shape of the laminations forming the lamination pack 7. The only difference consists in the fact that the pole tips 8 are longer than those of the lamination pack 7. In Figure 3 the shape of the poles of the lamination pack is indicated in chain dotted lines.

On the side remote from the lamination pack 7 the end plate 6 is provided in the area of the two pole faces with outwardly extending walls 9 and 10 respectively which are formed in the shape of a segment of a circle and extend parallel to the motor axis. The walls 9 and 10 extend along the edge of the parts of the end plate 6 corresponding to the pole shoes and the axial length is, in the example, greater than the overhang of the heads of the coils 1 and 2 in the axial direction. The radius of curvature of the inner surface of the walls 9 and 10 arranged concentrically to the bore of the stator pack is practically equal to the radius of curvature of the corresponding pole surfaces. Thus the walls 9 and 10 form an extention of the two pole surfaces in the axial direction. As shown in Figures 1 and 2, the free corner zones of both walls are chamfered off. A recess 9' in the circular zone parallel to the end plate serves for the attachment of a winding shoe during the coil winding operation.

On the side of the end plate 6 nearest the lamination pack 7 there are provided therein recesses 11 and 12 for the reception

of protuberances formed by lamination fastening means and solder tags respectively, so that the end plate can seat tightly up against the face of the lamination pack 7. In addition to these recesses further recesses 13 may be provided as shown in the example.

Furthermore, on this side the end plate 6 has two slot boundary walls 14 and 15 which, like the walls 9 and 10, are formed integrally with and perpendicularly to the end plate 6 but which, when the end plate 6 is applied to the front face of the lamination pack 7, extend towards the corresponding walls of the other half 5 of the insulating body. As shown in Figure 3, the walls 14 and 15 extend along the inner walls of the two slots 16, 17 and 18, 19 respectively formed between and behind the pole faces. However, due to the extension of the pole tips of the end plate 6 beyond the pole tips of the lamination pack the slot space defined by the walls 14 and 15 is greater than that which is formed by the lamination pack. The edges of the walls 14 and 15 extending beyond the pole tips and stiffened by projecting ribs 22 on the walls 9 and 10, the said ribs extending along the edges of the walls 14 and 15 beyond the pole tips formed integrally therewith.

The axial length of these projecting ribs is a little less than that of the walls 14 and 15. The walls in turn are a little longer than half the axial length of the lamination pack 7, so that the walls 14 and 15 may overlap centrally of the rotor tunnel.

In order that the wall thickness of the slot insulation in the region of the overlap shall be no greater than in the other parts and that the insulating body may consist of two identically formed halves, the walls 14 and 15, as shown in Figure 5, are reduced to half their thickness in the region of the overlapping edge zones. Figure 5 shows how the wall 15 is formed with a reduced edge 20 which forms a step which on one half of the periphery is disposed on the outside and on the other half on the inside of the peripheral zone.

The same applies to the wall 14 and the reduced edge or step 21 (Figure 4).

The production of the stator pack 3 is effected by first of all applying both halves 4 and 5 of the insulating body to the lamination pack 7 from the direction of the two ends. The walls forming the winding space overlap in the area between the two end faces of the lamination pack when the end plates are applied to the end faces of the lamination pack in such a way that an adequate creepage path is provided. Due to the steps 20, 21 the slot insulation is of the same thickness all over and no gap is left between the two halves 4 and 5. For the rest, the insulating body covers the slot space and the end faces of the laminated pack completely and without interruption.

After the insulating body has been applied the stator pack is fitted to the winding machine and the winding shoes, not shown, are placed in position. The centering of the winding shoes is effected with the aid of the walls 9, 10 extending outwardly and axially from the end plates. The coils 1 and 2 are now wound with the aid of a winding guide which is moved axially to and fro and is rotated over an adjustable angle around its longitudinal axis in the dead centre positions. The walls 9 and 10 of the half sections 4 and 5 of the insulating body prevent the turns of the coils 1 and 2 from sliding inwards near the coil heads.

This also prevents the wires from getting into the rotor tunnel and a reduction of the tautness of the wire is effectively prevented. Since due to the wire tension the wires are pressed against the end plates over the whole surface thereof small and compact coils are obtained which, need not be subjected to a shaping operation after completion of the coils.

The embodiment illustrated in Figures 6 and 8 differs from the embodiment shown in Figures 1 to 5 only in an alternative formation of the walls forming the slot space. The two embodiments are also alike as regards the design of the two halves of the insulating body, for which reason only those features of one of the halves will be further described which differ from the first embodiment.

Instead of the two walls 14 and 15 only a single wall 114 is provided on that side of the end plate 106 of one half of the insulating body which faces the lamination pack 107 indicated in dotted lines, and although the wall 114 extends, like the wall 14, along the edges of the two slots 116 and 117 the height of the wall in the axial direction of the lamination pack 107 is, in this case, somewhat greater than the axial length of the lamination pack. Instead of the step 20 a tapered edge strip 120 is provided. This tapered construction of the edge of the wall 114 facilitates the insertion into the end plate of the other half. The length of the projecting rib 122 of the wall 109 on the other side of the end plate 106 for reinforcing the edge of the wall 114 projecting beyond the pole tips is a little less than the axial length of the lamination pack 107.

Instead of the wall 15 the end plate 106 has an integral projection 123 and 124 respectively at the pole tips only, each of which consists of a short spigot shaped part, the cross section of which corresponds in shape to the projections 122, and an abutment surface of wedge section (Figure 8). The abutments 123 and 124 serve the purpose of supporting the walls 109 and 110 in the laminated pack and prevent these from being

pressed inwards past the pole surfaces under the winding pressure.

The assembly of the stator pack is effected in the same manner as in the embodiment according to Figures 1 to 5, but in this case the assembly of the two halves of the insulating body is simpler because overlapping ends do not have to be pushed one over the other.

WHAT I CLAIM IS:—

1. A stator assembly for an electric motor having salient poles, comprising a lamination pack having winding slots defining pole members and an insulating body having an end plate covering at least one end face of the lamination pack, the said end plate being integral with a part of the insulating body which covers at least half the total surface area of the sides of the winding slots, and in which each end plate includes a wall shaped like the segment of a circle and extending axially outward from the end plate in line with each stator pole member and also extending beyond the pole tips in the peripheral direction.

2. A stator assembly according to claim 1, wherein the axial length of the walls is substantially equal to the projection in the axial direction of the heads of coil windings provided on the pole members.

3. A stator assembly according to claim 1 or 2, wherein the radius of curvature of the inner surface of the wall arranged concentrically with reference to the bore of the stator lamination pack is at least equal to the radius of curvature of the corresponding pole surface.

4. A stator assembly according to claim 1, wherein each of the two edges of each segmental wall is provided with a rib-like projection which extends along the edge of the part covering the winding slot and extending in the same direction and projects into the pole gap.

5. A stator assembly according to any one of claims 1 to 4, wherein the free corner zones of each wall are chamfered.

6. A stator assembly according to any one of claims 1 to 5, wherein the wall has an aperture for fixing the position of a winding guide during the winding of the stator pack.

7. A stator assembly according to any one of claims 1 to 6, having two identical halves.

8. A stator assembly according to claim 7, wherein the parts forming the slot space overlap one another at mid-length of the lamination pack.

9. A stator assembly according to claim 8, wherein each part forming the slot space has a step of half the wall thickness in the region of the overlapping edge zones, the step being provided on one half of the periphery on the outside, and on the other half on the inside of the edge zone.

10. A stator assembly according to claim 7, wherein each half includes a part which covers one of the slots.

11. A stator assembly according to claim 12, wherein the terminal edge of the part which covers one of the slots can be inserted into the end plate of the other half.

12. A stator assembly for an electric motor, substantially as herein described, with reference to the accompanying drawings.

WHEATLEY & MACKENZIE,
17 Wilson Street,
London, E.C.2.
Chartered Patent Agents.

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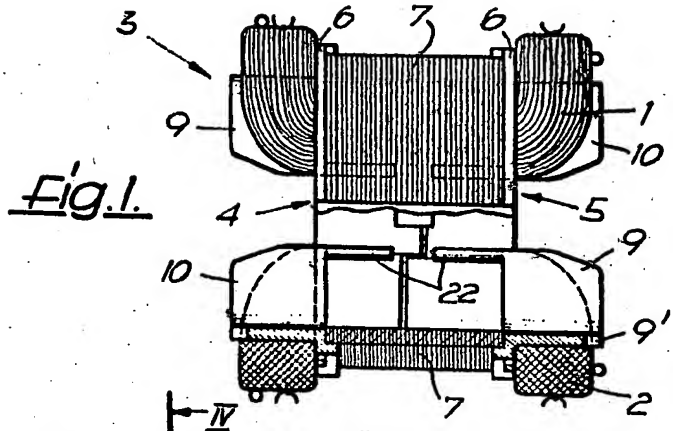

Fig.1.

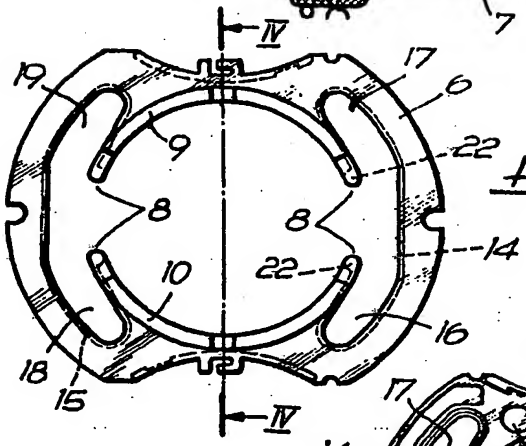

Fig.2.

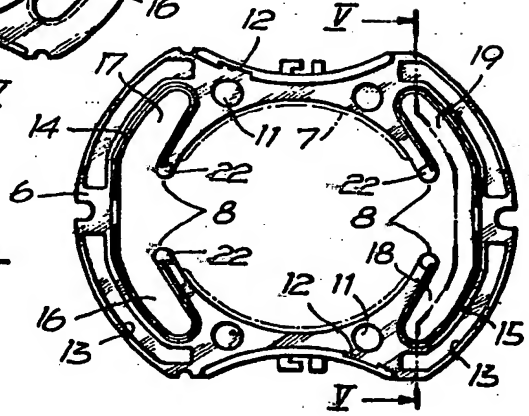

Fig.3.

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Sheet 2

Fig.4.

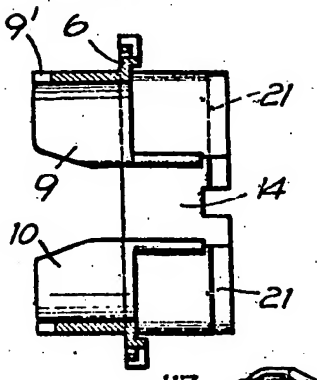

Fig.5.

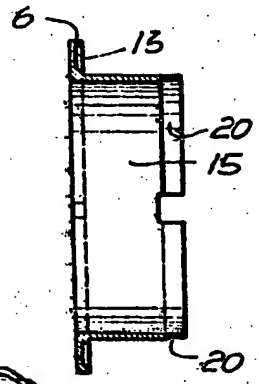

Fig.6.

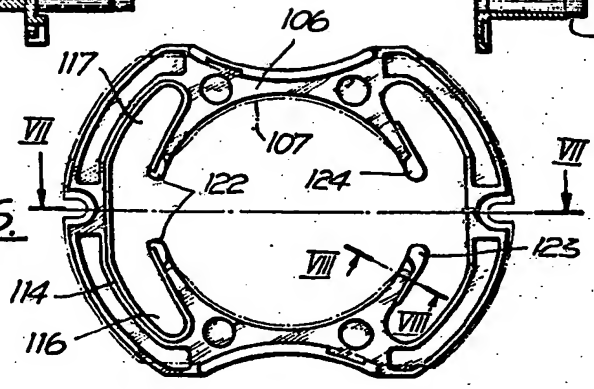

Fig.7.

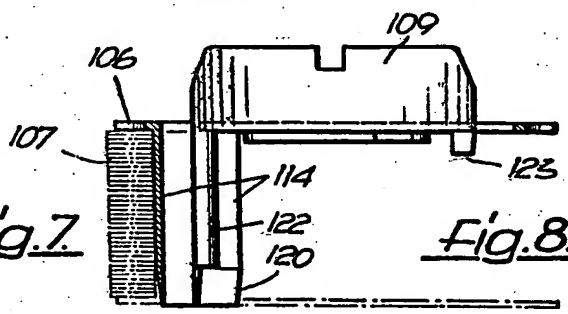

Fig.8.